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Ins. A1 ~~Specification~~

a ~~Communication system~~

The present invention relates to a communication system for connecting at least one telecommunication terminal apparatus and at least one computer device to a switching device.

Ins. A2

Analog telephone equipment is increasingly being replaced by digital equipment, based ~~predominantly on the ISDN standard (ISDN = Integrated Services Digital Network). ISDN is~~ Ins. A3 defined by several international digital communication standards that are recognized worldwide by telephone companies. ISDN technology is used to send both speech and data that can include graphics, sound ~~and~~, films and ~~[...]~~ digital signals via public telephone networks. The ISDN standard comprises digital standard transmission protocols, terminals and connection cables. The user is provided with two types of ISDN terminals. The international base terminal (S_0) comprises two B channels, each having 64 Kbit/s, and a D channel having 16 Kbit/s. The B channels transmit the useful information. The D channel is used for the signaling. Up to eight telephones or other terminal apparatuses can then be operated at an S_0 interface.

Besides the base terminal (S_0), the primary multiplex terminal (S_{ZM}), which is likewise internationally standardized, is also provided; it comprises 30 B channels and 1 D channel having 64 Kbit/s.

ISDN telephones can be operated directly at public networks or at private branch exchanges (PABX, Private Automatic Branch Exchange). In Germany, public communication networks standardly provide two-lead U_{k0} interfaces. In what is known as a network termination (NT), these U_{k0} interfaces are converted into a four-lead S_0 interface. For normal operation, the network termination requires energy from the public power network. In case of a power failure, the network termination (NT) supplies an emergency-supply-authorized terminal apparatus with energy from the public telephone network. Emergency operation is indicated by a reversal of the supply voltage at the S_0 interface.

Terminal apparatuses are preferably connected to private branch exchanges via the U_{p0} interface. The U_{p0} interface likewise transmits two B channels and one D channel. The U_{p0} interface, however, is not internationally standardized. For this reason, in addition to ~~it~~ the Upo interface, there also exist many other manufacturer-specific U interfaces.

Since the ISDN standard is a digital standard, it is particularly easy for computers to be connected to ISDN interfaces via plug-in cards. In contrast to speech transmission via telephone or image transmission using fax machines, computers offer the possibility of transmission of very different data formats. Thus, in the domain of the Internet, a multiplicity of image formats, speech compression methods, ~~up to~~ and formats for transmitting moving images, are used. The use of computers to send and receive faxes ~~belongs to~~ is well known in the prior art. With the corresponding software, a computer connected to a printer and to a scanner replaces a fax machine.

One problem in the contemporary PC world is the lack of flexibility of the interfaces used. A PC is standardly equipped with a keyboard interface, one parallel interface and two serial interfaces (RS - 232). The keyboard interface is occupied by the keyboard. One serial interface is allocated to the mouse, and the parallel interface is reserved for the printer. Only the second serial interface is available for additional peripheral devices. In the PC domain, data transmission via a serial interface is limited to a maximum of 115.2 Kbit/s. For this reason, peripheral devices that produce large quantities of data, such as ~~for example~~ scanners, are connected directly to computer-internal busses, such as the PCI bus or the ISA bus, via additional plug-in cards. However, ~~for this purpose~~ to use such peripheral devices, it is necessary to open the computer and install additional plug-in cards. Another disadvantage of the many different interfaces in the PC domain is the use of many different plug connections. In order to solve this problem, various bus systems are known in the prior art. In contrast to the PCI (Peripheral Component Interconnect) and ISA (Industry Standard Architecture) busses, an SCSI (Small Computer Systems Interface) interface can also be led out from the computer housing, and can in this way be used for the connection of up to seven peripheral devices having high data transmission rates, such as ~~for example~~ hard disks or scanners. A large number of low-price busses are available, such as ~~for example~~ the Apple Desktop Bus (ADB), the RS-485 interface, which represents an extension of the RS-232 interface, the Access.bus (A.b), the

Connection Highway Interface (CHI), the GeoPort, and, recently, the Universal Serial Bus (USB).

An essential goal in the definition of the USB standard was to provide a low-cost bus system for the connection of external peripheral devices to PCs. The USB bus offers low to medium data transmission rates (up to 12 MBit/s). It ~~The USB~~ is thus very well suited for the connection of a large number of peripheral devices, such as ~~for example~~ scanners, Personal Digital Assistants (PDAs), keyboards and mice. Up to 127 devices can be connected to the USB bus. In addition, the PCI bus supports plug-and-play functionality. The connecting cables are shielded four-lead lines. Two leads are ~~thereby~~ used for the transmission of a supply voltage of 5 volts. The two other leads are twisted, and are used for signal transmission. For data transmission rates of 1.5 MBit/s, unshielded untwisted cables are sufficient. The plugs are designed in such a way that one terminal apparatus can feed a maximum of 5 amperes into the supply line of the USB bus. The energy supply via the USB bus offers the possibility of producing peripheral devices without power supply units, thus saving costs.

PCs and other terminal apparatuses, such as ~~for example~~ telephones, can be connected jointly to public telephone networks or also to private branch exchanges. As long as the public telephone network or the private branch exchange provides an interface -- such as ~~for example~~ the S_0 interface or the U_{p0} interface -- that permits the connection of several terminal apparatuses, the PC and the terminal apparatus can be operated at the same interface, as indicated in Figure 3. For reasons of cost, telephones are standardly equipped only with the most necessary functions. The telephone or terminal apparatus in Figure 3 can thus only send data to, and receive data from, the private branch exchange (PABX). Consequently, in Figure 3 a communication between PC and terminal apparatus is possible only indirectly, via the private branch exchange (PABX). Additional manufacturer-specific solutions according to Figure 4 have also been created, in which, for example, ~~for example~~ the PC is connected with the private branch exchange (PABX) via an RS-232 interface, via a terminal apparatus (TE). The advantage of this solution is that at the PC side it is possible to use an already-existing interface, such as ~~for example~~ the RS-232 interface. It is disadvantageous, however, that this ~~that the cited~~ interface does not have the bandwidth required for complete controlling by the PC.

Figure 3 shows, in addition, the internal construction of a telephone. A telephone essentially has three user interfaces, namely a microphone (acoustic source), a loudspeaker (acoustic sink) and a keyboard for the dialing process (D channel). These three user interfaces, possibly supplemented by additional input and output units, are connected to the private branch exchange (PABX) or to the public telephone network via the telephone-internal IOM-2 bus (Input-Output Multiplexer) with the $U_{p0/E}$ or S_0 interface. The IOM-2 interface has a frame structure for three IOM channels. Each of these IOM channels provides four sub-channels, each having 64 Kbit/s bandwidth. In the IOM-2 frame structure, ~~among other things~~ 2 B channels (64 Kbit/s), one D channel (16 Kbit/s), one D* channel (16 Kbit/s), one CTRL channel (16 Kbit/s) and 2 IC channels (64 Kbit/s) among other things are applied. The B channels are used for data exchange with the switching center, preferably of speech data. The D channel is used for the exchange of control information with the switching center. The two IC channels are used for the exchange of data, preferably speech data, with additional terminal apparatuses, for example slave phones, and the D* channel and CTRL channel are used for the exchange of control information with additional terminal apparatuses. In the connection with an additional telephone (slave phones), the telephone that is connected with the switching center must be configured as a master phone.

US-A 4,748,656 discloses an interface arrangement that connects a communication system to a telecommunications terminal device. This interface is implemented by a plugin card in a personal computer that, on the one hand, controls the operation of the connected telecommunications terminal device and, on the other hand, offers services of the communication system. The complete signalling from the communication system is interpreted by the personal computer, converted into suitable control signals and forwarded to the telecommunications terminal device. The data received from the telecommunications terminal device are interpreted and modified in the personal computer. Suitable control and signalling messages are derived ~~therefrom~~ from this data that are then forwarded from the personal computer to the communication system. The connection of further peripheral devices to the interface between the personal computer and the telecommunications terminal device, however, is no more possible

than is stand-alone operation of the telecommunications terminal device when the personal computer is turned off.

"Isar -- läßt Daten statt Wasser fließen", ELEKTRONIK, Vol. 45, No. 20, 1 October 1996, pages 56-60 describes a semiconductor module both for digital as well as for analog data transmission. This module serves the purpose producing cost-beneficial, passive ISDN PC cards that, parallel to the data transfer with ISDN subscribers, can also communicate with subscribers in the analog network and transmit data. The functions of passive ISDN PC cards that are based on the semiconductor module described ~~therein~~ in this reference are comparable to those of active cards. In one applied example, the semiconductor module is connected to an ISDN transceiver via an IOM-2 bus and is connected to a PC bus interface via a local bus.

Summary Of The Invention

It is the object of the present invention to indicate a solution by ~~means~~ way of which a PC and a telephone can be connected~~, in which this is to be achieved~~ with a low hardware and software expense, and in which additional peripheral devices can be connected via the interface between the PC and the telephone.

This aim is achieved by ~~means~~ way of a communication system having at least one computer device, at least one telecommunication terminal apparatus, and a ~~switching means~~ switch that can be connected to a public telephone network. In this system ~~, whereby~~ the computer device and the telecommunication terminal apparatus are connected via a first bus system,

the telecommunication terminal apparatus is connected to the ~~switching means~~ switch via an interface,

the telecommunication terminal apparatus is provided with a first operating mode in which the reception data received from the ~~switching means~~ switch are rerouted by the telecommunication terminal apparatus to the first bus system, and are forwarded via the first bus system to the computer device.

In this system the computer device is provided with ~~means~~ a processor for processing the data received from the telecommunication terminal apparatus, and for the forwarding ~~of these~~ this data to the telecommunication terminal apparatus via the first bus system, whereby the data are emitted by the telecommunication terminal apparatus~~,~~.

The communication system is characterized in that the first bus system exhibits a greater bandwidth than a second bus system that is employed for the connection of individual, internal assemblies of the telecommunication terminal apparatus, and ~~in that, in addition~~ furthermore, that, in the first operating mode, the transmission data produced by the telecommunication terminal apparatus are forwarded via the first bus system to the computer device, the computer device processes the received data using the ~~processing means~~ processor, and the processed transmission data are sent back via the first bus system to the telecommunication terminal apparatus, and the telecommunication terminal apparatus reroutes ~~these~~ this data to the corresponding interface~~,~~ for forwarding to the ~~switching means~~ switch.

Preferred constructions of the present invention are discussed below ~~the subject matter of the subclaims~~.

Brief Description Of The Drawings

In the following, a preferred embodiment of the present invention is explained in more detail with reference to the accompanying drawings.

Figure 1 ~~shows~~ is a block diagram showing an inventive coupling between the PC and the terminal apparatus via the USB bus, ~~whereby~~ by which the PC is connected with the private branch exchange (PABX) indirectly via USB, and the PC terminal apparatus is connected with the private branch exchange (PABX) via a $U_{p0/E}$ interface, ~~whereby~~ in which the bandwidth of the USB interface is larger -- by at least the channels 2 IC, D* and CTRL -- than the bandwidth of the U_{po} interface.

Figure 2 ~~shows a~~ is a block diagram showing a layer model for the terminal apparatus according to Figure 1 that can be operated both in the conventional symphony mode (BRI) and also in the inventive butterfly mode (BFL),

a

is a block diagram showing

Figure 3, ~~shows~~ the logical data flow given a conventional connection of a PC and of a terminal apparatus to a private branch exchange (PABX) via an S_0 interface or a $U_{p0/E}$ interface, via 2 B channels and one D channel,

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Figure 4 ~~shows~~ is a block diagram showing a conventional cabling, given the connection of a PC to a private branch exchange via an RS-232 or S_0 interface via a terminal apparatus (TE),

Figure 5 ~~shows~~ is a block diagram showing an inventively constructed butterfly architecture, ~~whereby~~ in which PC and terminal apparatus (TE) are connected via a USB bus, and terminal ~~apparatus are [sic]~~ apparatuses are connected with the private branch exchange (PABX) via a $U_{p0/E}$ interface,

Figure 6 ~~shows a~~ is a block diagram showing a schematic representation of a data transmission in an inventive butterfly architecture in symphony mode, ~~whereby~~ in which the terminal apparatus is controlled by the private branch exchange in a conventional manner and no data are transmitted directly between PC and terminal apparatus (TE), and

~~Figure 7 shows~~ a schematic representation of a butterfly architecture in the inventive butterfly mode, ~~whereby~~ in which the terminal apparatus (TE) is controlled by the PC, ~~whereby in addition~~ in which the terminal apparatus only forwards the data between the private branch exchange and PC, and ~~whereby~~ in which, if necessary, the PC again forwards data via the USB bus to the terminal apparatus, for example, for loudspeaker output.

Description Of The Preferred Embodiments

According to a preferred embodiment of the present invention, shown in Figure 1, the terminal apparatus (TE), preferably a telephone, is connected physically with a private branch exchange (PABX) via a $U_{p0/E}$ interface. According to another embodiment, the terminal apparatus can be connected with a public telephone network via another interface, for example an S_0 or U_{k0} interface. PC and terminal apparatus are connected physically, preferably via a USB bus. In Figure 5, the cabling between PC, terminal apparatus (TE) and private branch exchange ~~is shown~~ that is required for the exchange of information according to Figure 1 is shown.

In principle, all known busses that can transmit a bandwidth of (4x64 Kbit/s + 16 Kbit/s) (4 B channels and 1 D channel) are possibilities for the physical connection between PC and terminal apparatus. However, the hardware expense in the terminal apparatus is particularly low if the physical interface between PC and terminal apparatus can accept the entire bandwidth of the IOM-2 bus, i.e., the entire IOM-2 frame structure (Figure 2). As was

previously mentioned ~~already mentioned above~~, the bandwidth of the IOM-2 bus is 12x64 Kbit/s. It thus corresponds to 12 B channels, or a total of 768 Kbit/s. This condition is particularly ~~in particular~~ not met by the serial interfaces (RS-232) and the S_0 interface (Figure 4). However, the required bandwidth is, for example, provided by the USB bus.

Since the USB bus is ~~therefore~~ able to transmit the entire IOM-2 frame structure, the two IC channels, the two B channels to the private branch exchange and the D channel need not first be expensively filtered out from the IOM-2 frame structure. Due to the fact that the entire IOM-2 frame structure is transmitted to the PC, the PC can control the terminal apparatus completely. This mechanism additionally allows ~~By this means, in addition~~ the data that the private branch exchange sends to the terminal apparatus (downlink) to be easily ~~can easily be~~ forwarded to the PC. In addition, by inserting data into the IOM-2 frame structure, the PC can easily send data indirectly to the private branch exchange. For direct communication between the PC and the terminal apparatus, two IC channels are supplied in each direction (uplink and downlink).

The IOM-2 frame structure does not occupy the complete bandwidth of the USB bus. For this reason, as shown in Figure 6, additional peripheral equipment can be connected to the PC via the USB bus. Possible devices for this purpose include, for example, microphones, chip card readers, speed dialing memories, keyboards, mice, and cameras for videotelephony.

Figure 2 shows the interleaving of the respective layer 1 bitframe structure in the terminal apparatus. The lowest layer is represented by the USB bus. The IOM-2 layer is located above the USB layer. The IOM-2 layer corresponds to layer 1 of the OSI layer model in the direction of the terminal apparatus. In the direction of the PC, layer 1 of the OSI model is represented by the USB bus. Layer 1 -- conversion IOM/USB -- takes place in a layer 1 converter (e.g. plug-in adapter in telephone) not shown here. Also not ~~(not shown here). Not~~ shown in Figure 2 is the LAP layer, which corresponds to layer 2 of the OSI layer model. Layer 3 of the OSI layer model is designated as a signaling protocol SIG PROT. The signaling protocol SIG PROT can be in two operating states. One operating state is the symphony mode. In symphony mode (see Figure 4 as well as Figure 6), the terminal apparatus is controlled by the private branch exchange PABX. The second operating state is the butterfly mode (BFL) (see Figure 5 as well as Figure 7). In the butterfly mode, the terminal apparatus only forwards data between

the PC and the private branch exchange, without reacting to them. Data (speech) between the PC and the terminal apparatus are exchanged via the two IC channels. The terminal apparatus receives commands from the PC via the control channel (CTRL) (see also Figure 7). The telephone can send control commands, such as keyboard inputs, to the PC via the D+ channel.

Figure 6 shows the logical flow of information in the symphony mode. The terminal apparatus communicates with the private branch exchange via the $U_{p0/E}$ interface. The connection (drawn in bold) ~~drawn in bold~~ to the private branch exchange indicates that the private branch exchange controls the terminal apparatus. The PC can ~~on the one hand~~ communicate with peripheral equipment via the USB bus and can communicate with the private branch exchange via the USB bus and the terminal apparatus. The symphony mode enables telephoning even when the PC is switched off. In symphony mode, the terminal apparatus is controlled by the private branch exchange.

Figure 7 shows ~~In Figure 7~~, communication in the butterfly mode ~~is shown~~. The terminal apparatus (TE) is controlled from the PC via the USB bus. This is represented by the USB lines drawn in bold. Data are exchanged only between the PC and the private branch exchange (PABX). These data are merely conducted through the terminal apparatus, and are converted between the $U_{p0/E}$ interface and the USB bus. The PC controls the terminal apparatus via the control channel (CTRL). Keypad inputs on the telephone are transmitted to the PC via the D* channel. The terminal apparatus and the PC can exchange data (speech) via the IC channels.

The butterfly architecture enables the pre-processing of data from the private branch exchange in the PC, and subsequent output on the telephone. Conversely, for example, speech inputs via the telephone can be pre-processed in the PC before forwarding to the private branch exchange. For example, the PC can carry out speech encryption. Here the PC would forward the speech data coming from the telephone to the private branch exchange in encrypted form. Encrypted speech signals from the private branch exchange are forwarded to the terminal apparatus in plain text. Since only one B channel to the private branch exchange and one IC channel to the terminal apparatus are respectively occupied, parallel operation of an additional B channel application in the PC is possible.

In addition, the butterfly architecture is suitable for the implementation of a telephone answering device on the PC. The PC is characterized by high computing power and large memory capacity on the hard drive. For the implementation of a call answering device function in the butterfly architecture, it is thus sufficient to expand the software on the PC. The speech input and output preferably takes place again via the telephone. Alternatively, additional peripheral devices can, for example, be connected to the PC.

Another preferred field of application of computer-telephone integration using the butterfly architecture is videotelephony. The standard H.320 provides a standard for narrow-band image transmission. Since a display screen is already available in the PC, only a camera for recording the image is required. This camera can, for example, be connected to the USB bus. According to the H.320 standard, one B channel of the $U_{p0/E}$ interface is used for the video transmission. The second B channel is available for speech transmission (multiplexed with image data). Speech data are inputted and outputted via the telephone. According to the butterfly architecture, speech data are first exchanged between PC and telephone via an IC channel. The PC sends the speech data to the private branch exchange via a B channel. The speech data are thereby conducted through the telephone. This ~~apparently complicated~~ method makes it possible to keep the hardware expenditures ~~outlay~~ as low as possible, particularly in the telephone, and to standardize the telephone software to the greatest possible extent.